1903.—No. 4.

DEPARTMENT OF THE INTERIOR.

BUREAU OF GOVERNMENT LABORATORIES.

SERUM LABORATORY.

Preliminary Report on the Study of Rinderpest of Cattle and Carabaos in the Philippine Islands.

BY JAMES W. JOBLING, M. D.,
Director of the Serum Laboratory.

MANILA:
BUREAU OF PUBLIC PRINTING.
1903.

6277

1903.—No. 4.

DEPARTMENT OF THE INTERIOR.

BUREAU OF GOVERNMENT LABORATORIES.

SERUM LABORATORY.

Preliminary Report on the Study of Rinderpest of Cattle and Carabaos in the Philippine Islands.

BY JAMES W. JOBLING, M. D.,
Director of the Serum Laboratory.

MANILA:
BUREAU OF PUBLIC PRINTING.
1903.

6277

LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
BUREAU OF GOVERNMENT LABORATORIES,
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,
Manila, P. I., May 21, 1903.

SIR: I have the honor to forward herewith a paper entitled "A Preliminary Report on the Study of Rinderpest of Cattle and Carabaos in the Philippine Islands," by James W. Jobling, M. D., Director of the Serum Laboratory.

I am, very respectfully,

PAUL C. FREER,
Superintendent of Government Laboratories.

HON. DEAN C. WORCESTER,
Secretary of the Interior, Manila, P. I.

A PRELIMINARY REPORT ON RINDERPEST OF CATTLE AND CARABAOS IN THE PHILIPPINE ISLANDS.

By JAMES W. JOBLING, M. D., *Director of the Serum Laboratory.*

This preliminary report is especially intended as a circular of information to the cattle shippers and breeders of the Philippine Islands; giving them the symptoms, means of prevention, and treatment of rinderpest, and, as a consequence, scientific discussion and technical terms have been avoided wherever possible. The Civil Government intends to immunize all the cattle and carabao now on these Islands, as well as those to be imported. To accomplish the best results, it is necessary for cattle shippers and breeders to become thoroughly acquainted with the diesase in order to successfully coöperate in the work.

In the following, articles written by numerous authors have been consulted and free extracts made.

Definition.—According to Gamgee, "Rinderpest is a specific, malignant, and highly contagious disease, known to us only as the result of direct or indirect communication from sick to healthy animals. It never originates spontaneously, but is perpetuated by constant reproduction, after the manner of other contagious diseases. It is essentially a bovine disease, although it is claimed it may be communicated to swine, goats, sheep, deer, antelopes, gazelles, and zebras, seldom attacking any animal more than once." My own definition would be that it is a specific, infectious disease, characterized by congestion and inflammation of the mucous membranes, more particularly of the digestive tract.

It is marked by a period of incubation of from three to ten days; by fever, which precedes all other symptoms; redness of all the visible mucous mebranes, seen early and in a marked manner in the vagina of cows; sometimes delirium and muscular twitching; discharges from the eyes and nose; normal secretions checked or suppressed; abdominal pain with diarrhea, although in certain instances there may be constipation. In some epidemics a scaly eruption on the back and loins and a characteristic one on the inside of the thighs and on the mammæ, together with fetor of the breath and discharges are observed. The majority of animals seized with rinderpest die, and, after death, decomposition rapidly takes place.

The following brief historical retrospect is taken from an extract of Fleming's work on Animal Plagues, and Gamgee's work on Cattle Plague, as given by Edington in his annual report to the Colonial Secretary, Cape Town, for the year 1897.

The date of the first account of a disease among cattle which probably was rinderpest is given as A. D. 69. Columella, who lived at that time, and who, according to accounts, had considerable influence on the progress of veterinary medicine, has written of many of the diseases of the lower animals. In the ninth chapter of the sixth book, in describing the symptoms of the fever, he says:

"The fever is present when the tears are running down the face; when the head is carried low and heavily, and the eyes are closed; when the saliva flows from the mouth; when the respiration is shorter than in health and seemingly embarrassed, or sometimes accompanied by groaning."

He further insisted on the most sensible procedure of separating the sick from the healthy stock.

Since that time epidemics of greater or less extent have from time to time attacked the cattle on large areas of the globe.

Rinderpest has caused the death of several million cattle in Europe alone. In A. D. 360, eastern Europe was visited by an epidemic of an exceedingly virulent character, which caused an enormous loss, the cattle apparently dying almost as soon as they became sick; in A. D. 591 Italy, France, and Belgium developed a scourge which left scarcely sufficient cattle to breed from; in the year 694 England suffered from an epidemic which caused untold suffering; and during the year 801 France was again severely afflicted.

From this period up to the beginning of the eighteenth century, when our knowledge of epizootic diseases becomes more exact, numerous epidemics of a virulent disease appeared among cattle in all parts of Europe, causing immense loss and great suffering.

In 1708 Kanold asserts that rinderpest had commenced its destruction in Russia, from which country it spread to all parts of Europe. Of all the descriptions of this epidemic relating to the nature and spread of the cattle plague, probably the best are those of Lancisi and Ramazzinni, two physicians who gave special attention to the disease. Their description of the symptoms corresponds with those encountered in the Philippine Islands, with this exception: I have never seen, either at this Laboratory, where the animals have contracted the disease by means of natural infection and by inoculation, or in the provinces, where the disease is contracted by natural infection alone, cases covered with pustules and small tumors. From the frequency of the pustules in the cases observed by Lancisi and Ramazzinni, they concluded that the disease was similar to and identical with smallpox in man.

In Holland, during the year 1713, 200,000 animals are supposed to have succumbed to the disease, and between 1711 and 1714 over 1,500,000 died in western Europe; in the interval between 1840 and 1843 Egypt lost over 665,000; in 1865, 500,000 were destroyed in England; and from 1884 to 1894 Russia lost over 1,815,000.

The disease is now present in India, China, Africa, the western part of Russia, and is said to be endemic in the Balkans.

In the Philippine Islands rinderpest apparently first appeared in 1882, when the Spanish Government issued a pamphlet instructing the people in methods of diagnosis and treatment, and from this period until the present time it has extended to most of the Islands of the Archipelago, causing a loss of many of the cattle and carabao, estimated by some to be as high as 90 per cent.

METHODS OF TRANSMISSION.

The cause of rinderpest is not known, but from its being so very infectious, and from the fact that it is so easily conveyed by the blood, it is probably produced by some microörganism the nature of which we have been unable to determine. The infection is carried but a very limited distance in the atmosphere, or by running water. The usual method of transmission is by means of infected ground, but it can also be conveyed by any of the excretions, such as the discharges from the nose and mouth, the stools, and, according to some authors, by the bile; by buckets and other objects which have been in contact with the sick animal; by means of the indiscriminate disposal of the offal, or by allowing the excreta to pass by way of an open drain into or through a pasture containing healthy cattle; by means of men attending sick animals and carelessly carrying the infection upon their shoes to a place where healthy cattle are kept; by dogs or wild hogs, which, if allowed access to the carcass of an animal dead with rinderpest, may tear it to pieces and scatter the bones and fragments of flesh to new areas of ground, which thus become infected. It can also be conveyed by means of the hides removed from animals dying of rinderpest. One source of great loss to cattle shippers is in transporting cattle on ships which, without proper disinfection, have previously been transporting diseased animals.[1]

[1] This latter danger has been shown conclusively during the work in this Laboratory, where we are compelled to obtain our calves for vaccine virus, and cows for the preparation of serum from China. With but very few exceptions, every shipment of calves or cows we have received has either shown some of the first symptoms of the disease (high temperature) on admission, or has developed the same within twenty-four hours.

One instance of this occurred very recently. Fifty calves were five days in transit from Hongkong to this port, and within seventy-two hours after admittance to this Laboratory for immunization, twenty were dead. In this case two died within twenty-four hours after admission, while, with the exception of four, all showed a temperature of 41° C. or over.

As the incubation period of rinderpest is from three to ten days, it can be seen that the infection must have taken place either aboard the ship or in Hongkong just previous to shipping, as after arriving at the Laboratory the majority died before they had passed the regular incubation period, whereas if the infection had taken place here the animals would hardly have shown serious symptoms before eight or ten days.

In experimental work it has been proven that 0.1 c. c. of blood taken from a sick animal and injected under the skin of a healthy one is sufficient to reproduce the disease.

Edington states that if a small amount of the discharge from the nose of a sick animal be rubbed on the muzzle of a healthy one the latter will contract the disease almost as quickly as if it had been inoculated with virulent blood, but if this discharge be kept twenty-four hours before applying to the healthy animal, the disease is greatly modified in type. He further mentions that in localities in which red-water or Texas fever was present, and where he was afraid to inoculate with virulent blood for fear of conveying the Texas fever parasite, he diluted the blood with a large quantity of water and drenched the animal with it. In these cases they contracted the disease about as quickly as when inoculated. In a series of experiments, made in order to find out the maximum length of time rinderpest would live in the dried state, he added sufficient blood to dry sawdust to give it a bright-red color and allowed the mixture to stand at room temperature for six days. He found that 2 grams of this mixture would produce the virulent disease.

Hutcheon states that complete desiccation destroys the infection, and that putrefaction apparently has the same effect.

From the above it will be very readily seen what a great mistake it is to allow an animal sick with rinderpest to remain at large, with the subsequent danger of infecting all the remaining stock in the vicinity. If a few precautions were taken the danger would be reduced to a minimum.

GENERAL PATHOLOGICAL ANATOMY.

The body is emaciated. There is often an excoriation of the skin below the inner canthus of the eye, produced by the irritating discharge during life. The tail and buttocks are often soiled by the fecal discharges.

So far I have been unable to determine any specific cutaneous lesions, especially none of those reported by the older writers.

In one case (carabao), in which the animal was sick about twenty days, a pustular eruption appeared about the fifteenth day. This eruption was discrete, but the pustules were very close together and scattered over the entire surface of the body, apparently showing no predilection for any one part.

The natives in the provinces claim that many of the convalescent animals show a scaly appearance of the skin, but we have never noticed this condition in a sufficient number of cases to be able to say that it generally accompanies the disease.

The skin covering the upper lip is often thickened and excoriated by the discharge from the nose.

The conjunctivæ are nearly always congested, more especially in carabaos, in which animals they are generally a bright-red color. I have seen a number of cows sick with rinderpest, where the conjunctive showed

practically no changes. These cases generally occurred in animals which had been inoculated with the disease.

The mucous membrane of the nose generally, and over the septum in particular, is deeply congested. It often appears of a purple color. In a few cases I have noticed superficial ulcerations on the anterior portion of the septum, but I am inclined to think that they were due to some other cause.

Most writers upon rinderpest lay stress upon the frequency with which ulcers are to be found in the mouth. This is contrary to our experience at this Laboratory, for while the great majority show a marked congestion of the mucous membrance, with a covering of thick, slimy mucus, comparatively few show ulcerations.

Ulcers sometimes appear on the dorsum of the tongue, accompanied with marked congestion.

The fauces and pharnyx are the seat of a catarrhal inflammation and covered with thickened mucus.

Edington states that in many of his cases the tonsils showed pin-head abscesses in the cortical layer.

The mucous membrane of the œsophagus and trachea, as well as in other parts of the body, may be deeply congested, but in the majority of cases appears normal.

The lungs generally appear perfectly healthy. In some cases there is a congestion, but I believe this to be principally hypostatic, due to weakened heart action. A number of cases showed an emphysematous[1] condition.

The pericardium contains about the usual amount of fluid and appears normal. The parietal lining sometimes shows a few subserous hemorrhages.

It is not uncommon to find petechiæ (minute dark-red points) scattered over the surface of the heart.

The muscular tissue is generally paler than normal, and shows a condition of marked cloudy swelling. In the cavities of the heart the blood seldom coagulates firmly, either forming a soft coagulum or having a sirupy consistence. The endocardium or lining membrane often shows minute hemorrhages.

The general lymphatic system seems to be affected in this disease, as in the majority of cases almost all of the lymphatic glands of the body appear enlarged, and in some cases present an edematous appearance. This condition is best seen in the abdominal cavity, where the glands in the mesentery supporting the small intestine are almost invariably greatly enlarged, and in some cases hemorrhagic.

The rumen (first stomach), the reticulum (second stomach), and omasum (third stomach) are generally normal in appearance, although the contents of the last are always very dry and the mucous membrane sometimes slightly congested.

[1] Dilated air cells in the lungs.

The abomasum (fourth stomach) is usually the organ in which the most marked pathological changes are found. The contents are generally fluid, and consists of a large amount of mucus and often of considerably blood mixed with the food. The odor is very foul.

The changes in the mucous membrane vary from a slight congestion, generally localized at the pyloric or lower end, to an extreme one with ulcerations, involving the mucous membrane of the entire organ.

Very often minute hemorrhages about the size of a pin head will be found over the deeply congested areas. Numerous small ulcers are often present, more often at the pyloric or lower end. They are generally shallow, with the bottoms covered by a greyish-yellow exudate. I have seen cases in which the ulcer extended completely around the pyloric orifice.

The upper portion of the small intestine is invariably congested, almost to as great an extent as is the fourth stomach, and it often shows the minute hemorrhages so frequently observed in the latter. I have never seen more than two or three cases in which there were ulcerations in this location; these are apparently confined to the fourth stomach and cæcum.

In the severest form of the disease, the feces show casts from 12 to 35 centimeters in length and postmortem examination demonstrates a diphtheritic condition of the upper portion of the small intestine with pseudomembraneous formation.

In many cases the mucous membrance of the remainder of the intestine is so slightly affected as to appear normal, while in others there is the most extreme congestion, with the formation of casts. Peyers patches are often enlarged, but, in my experience, never ulcerated. I have never seen ulcers in this portion of the intestine. A marked congestion is very often seen around the ileo-cecal valve, with small submucous extravasations of blood.

The cecum is generally merely the seat of a congestion, but in other cases it is violently inflamed, showing ulcerations, hemorrhages, etc.

The colon is frequently congested, but the changes are not so far advanced as those seen in the upper part of the small intestine and in the fourth stomach.

The peritoneum often shows signs of an acute localized inflammation, involving that portion covering the small intestine, which is often coated with a fibrous exudate.

The peritoneal cavity usually contains a larger amount of fluid than is found in a healthy animal.

The liver is greatly congested, often presenting a mottled appearance, and shows evidence of marked cloudy swelling. It is frequently bile-stained.

The gall bladder is distended with bile, which is usually green in color, but I have seen all shades, from a light yellow to black. The mucous

membrane usually appears healthy, but sometimes is markedly congested, covered with a tenacious mucus and showing the petechia or pin-head hemorrhages described above as occurring in the fourth stomach and elsewhere.

The kidneys are congested, in some cases showing numerous petechia scattered over the capsule of the organ.

The surface of the spleen appears of a slate color and wrinkled. The organ does not appear to be greatly congested and is about normal in size.

The vagina is always greatly congested.

The mucous membrane of the bladder, like that of other portions of the body, may be deeply congested, but is usually normal. Some cases present a hemorrhagic appearance.

SYMPTOMS.

Our observation of rinderpest resulting from natural infection has been almost entirely confined to the disease occurring in animals which have contracted it previous to their admission to this Laboratory but which have shown the first symptoms two or three days afterwards, and to that developed by individuals which have been put on a small area of ground, previously infected by the excreta and discharges of animals dying of rinderpest. The animals were tied to stakes which had been driven into the ground in the center of the infected paddock, and their food was placed in such a position as to mix it more or less with the infected excreta.

The incubation period in those animals contracting the disease from this exposure varied within a range of from six to ten days. In no case have I seen it less than six days. The earliest rise of temperature observed is about fifty-one hours after inoculation with nasal mucus (Edington).

In animals inoculated with virulent blood the incubation period is from sixty to ninety-six hours. The rapidity of onset and sometimes the intensity of the subsequent disease depending, first, upon the virulence of the disease in the animal from which the blood was obtained; second, upon the length of time the latter has been kept and third, upon the quantity used for the inoculation. The average time before the first rise of temperature is about seventy-two hours. In case the animal is inoculated with a large dose (10 c. c. to 25 c. c.) a rise of temperature is often noticed on the evening of the same day, but the temperature generally falls to normal on the following morning and remains so until the period of incubation has passed.

Generally on the evening of the fourth day after inoculation a rise in temperature to 40 to 40.6 C. will be noted.[1] It does not remain high in all cases, but sometimes drops to normal on the following morning,

[1] In the Philippine Islands, a healthy cow's evening temperature will average about 39° C.

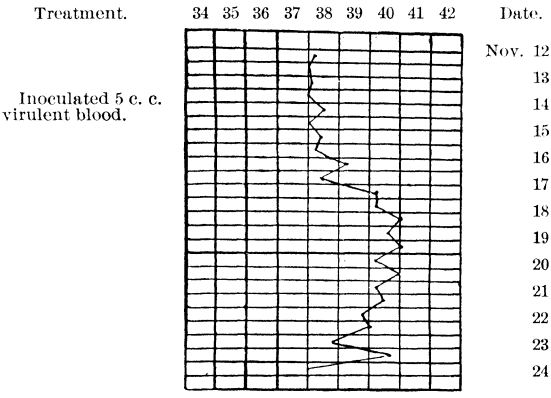
remaining so for twenty-four hours and then again rising to over 40° C., remaining high, with slight morning remissions until just before death, when it rapidly drops to subnormal.

The temperature curve in an inoculated animal is well shown in Chart No. 1.

CHART NO. 1.

Cow No. 45, November 12, 1902.

[Weight, 400 pounds; age, 2 years; sex, female; color, light brown; inoculation, rinderpest; history, inoculated November 14, 1902, with 5 c. c. virulent blood from calf No. 56.]



About twenty-four hours after the first rise of temperature it will be noticed that the muzzle is somewhat dry, and the animal appears less inclined to take food. About the same time the mucous membrane of the inner portion of the eye becomes injected and soon presents a vivid pink color with a slight watery discharge running down the face from this point. In many instances this is the initial visible symptom of the disease. The mucus discharge from the nose is much augmented. The bowels are somewhat constipated, although the feces are often coated with slimy mucus. The hair is rough.

The animal shows great thirst; and if in the open, leaves the herd; and, if water is near, will stay by it; the ears hang forward; the head droops, while flies gather about it and no great effort is made to dislodge them. There may be twitching of the superficial muscles of the back, shoulders or hind quarters; rumination is irregular or ceases, grinding of the teeth becomes almost constant. When the animal is lying down the head is commonly turned toward the flank. With the exception of those cases noted above, the temperature at this time is very high, in many cases being over 41° C.

About forty-eight hours after the first rise of temperature the hardened feces give place either to a foul-smelling, discolored watery discharge containing mucus flakes and blood, or to a dirty, thick, slimy fluid containing streaks of blood and in some cases mucus casts. The other symptoms now all become aggravated. The discharges from the

eyes, nose, and mouth are increased in amount, that from the nose is changed in character, being now thick and muco-purulent, while the skin of the upper lip over which the secretions have been running becomes thickened, dry, and excoriated. The breath has a very offensive odor. Prostration is very great; the animal while standing trembles from weakness; there is extreme thirst. It soon lies down, moaning; the liquid feces are passed almost continually with great straining, finally involuntarily, the animal groaning from the tenesmus. It rapidly becomes weaker, the respirations are more rapid and labored; finally, just before death, the temperature drops to subnormal.

The symptoms described above are not constant, either in the order given, character, or severity.

The duration of the disease from the first rise of temperature until death is usually from two to ten days, the average being about six.

If rinderpest is of a milder type, the stools after a few days lose the mucus and blood streaks, and gradually assume their normal consistency, all the other symptoms abating at the same time.

I have noticed that a larger percentage of carabaos than of cattle show the highly injected conjunctivæ, and that following the "simultaneous method" of inoculation, when a diarrhoea does appear, it generally does so at an earlier stage with carabaos than with cattle.

The great majority of the animals which are affected die. Some authorities state that the mortality is from 60 to 80 per cent, but here in the Philippines I believe it to be much higher, especially in the rainy season. This is also noticed by the natives, who maintain that while in the wet season most of the animals die, in the dry season many recover.

In this respect it is interesting to note that in regions where wild hogs are numerous the natives state that they find dead hogs as the epidemic rises in extent and virulence. They explain this by the theory that the wild hog contracts the disease while eating the carcasses of animals dead with rinderpest. In the Pasteur Institute it has been found that hogs are susceptible to the disease, and in view of this the above does not seem improbable.

In this Laboratory we have had no opportunity to experiment with wild hogs, but procured two farm-bred animals, one of which was inoculated with 5 c. c. of virulent blood. The animal appeared dull on the day after, had very little appetite, and was lying down most of the time, with no other symptoms. The temperature on the evening of inoculation was 39.5° C.

On the third day after the inoculation the animal showed distinct signs of illness, the back was arched; head hanging; no appetite; extreme thirst; conjunctivæ slightly congested, with a discharge from the inner angle of the eye; the hog lying down most of the time. The respiration was rapid. The morning temperature was 40.2° C. and the evening 40.4° C.

On the fourth day there was a profuse yellowish, watery diarrhea, the animal appearing to have involuntary discharges part of the time.

There was no mucus or blood in the feces at any time. With the exception of the diarrhea, the animal showed the symptoms it did on the previous day, although it was now weaker.

On the fifth day the diarrhea had disappeared; the animal was still very weak, but the temperature had dropped to normal. The hog was now bled to death, the blood being drawn into potassium citrate solution and used to inoculate hog No. 2 and cow No. 46.

The postmortem showed no marked lesions, with the exception of a slight hyperæmia of almost the entire alimentary canal.

Hog No. 2 received 5 c. c. of the blood, but never developed any symptoms of the disease.

Cow No. 46 received 7 c. c. of the blood and, after the usual incubation period, showed the typical form of rinderpest, although the symptoms were much milder than is generally seen after inoculation with such a large quantity of virulent blood. Unfortunately no other nonimmune cattle were on hand to test the blood drawn from this cow, so that further experiments were prevented. This animal was bled to death. The postmortem lesions were those usually seen in rinderpest, although not so far advanced.

This hog had the shortest incubation period of any animal I have seen, and I would have believed it to be suffering from some other disease had cow No. 46 not developed typical rinderpest after the regular incubation period.

From this one series of experiments it would appear that while the hog may contract the disease and die, and its excreta may form a source of infection for cattle and carabao, yet it is difficult for the sick hog to reinfect others of its kind. However, no definite conclusions could be based upon the evidence at my disposal, and the work will be continued when opportunity offers.

Some experiments are now being conducted in the provinces to determine the susceptibility of the wild hogs, and to see if they are able to comunicate the disease to others.

PREVENTIVE MEASURES.

When an animal shows any symptoms of the disease as given on pages 11, etc., it should be immediately isolated. By isolation I mean that it should be entirely separated from the remainder of the herd and placed on a small inclosed area, so situated that after it dies or recovers the ground and everything which has come in contact with it can be thoroughly disinfected. It could be kept on the spot where found, temporarily fenced in, and with a bamboo and nipa covering to protect it from the rays of the sun. The excreta should not be allowed to enter a drain and so infect surrounding territory, but should be retained on the spot and thoroughly disinfected either with crude carbolic acid in a strength of

about 3 per cent, or by the addition of good chloride of lime, or buried. The attendant, if a native and not wearing shoes, should thoroughly disinfect his feet as well as his hands with a per cent solution of carbolic acid, before coming in contact with other animals.

If he wears shoes, he should have two pairs, one to wear while working with the sick animal, the other (which should be left on the outside of the inclosure) to be put on when leaving.

After the animal dies or recovers, the shelter should be burned on the infected area, and the entire surface of ground within the inclosure, as well as that on which the animal has been browsing or lying, disinfected with carbolic acid or chloride of lime. It would be still better, after sprinkling with carbolic acid or chloride of lime, to cover the ground with dry grass and then set fire to it.

The remainder of the herd must be transferred to new pastures and there kept separate from one another, and the temperatures of all taken daily. Any animal showing a temperature above normal, or any of the symptoms described on page 12, should be immediately isolated in the manner above described, and the herd once more moved.

By following these precautions I believe an epidemic of rinderpest can be suppressed in its beginning, and only those animals which are in the incubation stage at the time the disease is first recognized will further develop the disease.

The bodies of the animals which have died of the disease should be either burned or buried. It is better to burn them; but if this can not be done, care should be taken to bury them so deeply that hogs and other animals can not exhume them and scatter the bones and fragments of flesh around the surrounding country, in which event new points of infection would probably be formed.

A very careful search should be made for the source of the primary infection, so that after suppressing the disease in the herd it may not be reintroduced.

As the hides removed from animals dying of rinderpest convey the disease, they should be thoroughly disinfected with a 1 per cent solution of carbolic acid, allowing them to remain in this solution for several hours, and then hanging them in the hot sun until thoroughly dry, turning them over several times so that the rays of the sun will strike all parts. If they are to be sent from the infected locality, it would be better to redisinfect them before shipment. I have given directions for the disinfection of the hides because their retention may be insisted upon. My own opinion, however, is that it would be better to destroy them with the carcass.

IMMUNIZATION.

There are a number of different methods of immunizing cattle and carabaos against rinderpest, several of which will be described, with their advantages and disadvantages.

INOCULATION BY A MIXTURE OF GLYCERIN AND BILE TAKEN FROM AN ANIMAL SICK WITH RINDERPEST (EDINGTON'S METHOD.)

Edington recommends the use of bile taken from an animal which has been sick six days, preferably from one which has contracted the disease by natural infection, because he found greater immunity conferred thereby than by that taken from animals inoculated with virulent blood.

The bile, according to his directions, should be green, having a white froth on the surface and possess no putrefactive odor. To obtain it, open the abdominal cavity of the dead animal, tie the neck of the gall bladder with two strong ligatures of twine and cut between them. The bile can then be secured by one of several methods, viz: Immerse the bladder in a bucket of 2 per cent carbolic acid, then wash in cool water which has recently been boiled, and open the bladder with a knife which has also been boiled, allowing the bile to flow into a vessel recently sterilized by thoroughly washing with *boiling* water; or, after the bladder has been disinfected, the bile can then be obtained by means of a trocar and canula, hollow needle, or even a sharpened small piece of bamboo which has been sterilized. If found to be satisfactory, half its volume of glycerin is added to the bile, and the mixture is then kept in a cool place for eight days; after which it is ready for use. The inoculator should not take the bile from the dead cow, as he is liable to carry the infection to the animals he is inoculating.

Of the bile thus prepared, 15 to 30 c. c. is injected under the skin of the dew-lap. The syringe which is used for this purpose should be allowed to remain in a 3 per cent solution of carbolic acid for about thirty minutes, and before using should be washed out with water which has been freshly boiled. It would also be well to wash the skin where the inoculation is to be made with the same carbolic-acid solution. After ten days the animal should be reinoculated with 0.2 c. c. of virulent blood.

The advantages of this method are: First, there are practically no deaths following the inoculation; second, after preparing the bile it can be kept ready for use for about one year; third, pregnant animals seldom abort.

The disadvantages are: First, the immunity thus produced lasts a very short time, generally from two weeks to three months; second, very little immunity is conferred until after ten days; third, in some animals no immunity is produced at all; fourth, the small quantity of bile secured from each animal makes it necessary to allow a number of animals to contract the disease in order to obtain a sufficient amount for the immunization of the remainder of the herd; fifth, it requires two inoculations; sixth, it is necessary to bleed a sick cow to get virulent blood for the second inoculation.

SERUM METHOD.

Koch demonstrated that the serum of the blood taken from an animal which had suffered from rinderpest and recovered possessed immunizing powers.

The serum which is used for this and the following methods is prepared by inoculating cattle with gradually increasing doses of blood taken from an animal sick with the disease, until they can bear very large quantities.

The animal first receives the "simultaneous method" of inoculation described on page 18. If it shows a good reaction, i. e., rise of temperature after the proper period, it is given 100 c. c. of virulent blood after the temperature again drops to normal. This is subsequently, and under the same circumstances, followed by 500 c. c. and afterwards by 1,000 c. c.

If the animal does not show a good reaction within ten days after "simultaneous inoculation," it is given 10 c. c. of virulent blood. If a good reaction follows this dose, and after the temperature drops to normal, it received 250 c. c. of virulent blood, then ten days later (or after the temperature becomes normal) 500 c. c., and finally 1,000 c. c. After receiving a dose of 1,000 c. c. the animal is bled for serum.

In bleeding our serum animals, they are strapped upon the operating table, a small area over the jugular vein is shaved clean and sterilized with a 3 per cent solution of carbolic acid, followed by alcohol. The instruments are also sterilized in a 3 per cent carbolic-acid solution.

After sterilization is completed, a short incision is made over the course of the jugular vein. The latter being exposed, a trocar and canula are inserted into it. It is better, when the trocar is withdrawn, to attach a piece of rubber tubing to the canula, for if this is not done, the animal in its struggles may upset the vessel into which the blood is being drawn or cause the previously sterile vessel to become infected. The blood is allowed to flow into tall glass cylinders holding 500 c. c. each, about three liters being taken at one operation. It is then set aside for twenty-four hours, at the end of which time the clot will generally have contracted quite firmly and will be surrounded by the clear serum; this is drawn off by means of sterile pipettes or by a syphon.

After this operation the clots should be allowed to stand for an additional twenty-four hours, as at the end of that time some additional serum can be obtained.

Following Roger's plan, the animals, after receiving 1,000 c. c. of virulent blood, are allowed to remain until the temperature becomes normal. They are then bled three times with an interval of one week between each bleeding, after which they are inoculated with 1,500 c. c. of virulent blood and bled in the same manner as before.[1]

[1] My assistant, Mr. Chas. S. Sly, has had charge of the preparation and handling of all serums, while Dr. J. G. Slee, assistant veterinary surgeon to the city of Manila, has done nearly all of the bleeding, had charge of all the inoculations, as well as the general supervision of the stock on hand. A great deal of credit is due them for their valuable work in assisting in the suppression of the epidemic now prevalent in these Islands. Their work has not been confined to this Laboratory, but has extended to the provinces, where they heve inoculated a great many cattle and carabao.

In using the serum, 50 to 100 c. c. should be injected under the skin, using the precautions given above.

The advantages of this method are: First, that it produces no reaction; second, in dairy cattle there is no suppression of milk; third, the immunity conferred is almost immediate; fourth, if the disease is just developing, it will often modify the attack, making it much milder in type; fifth, there are no deaths as a result of the inoculations; sixth, pregnant animals do not abort; seventh, the serum can be prepared in any quantity and it will keep during seven or eight months.

The disadvantages are: First, the short period of immunity, it averaging from two to four months; second, the skill required in preparing the serum; third, I believe sometimes very little immunity is conferred, as I have seen cases in which a small quantity of virulent blood, given from ten to fifteen days after the inoculation of serum, would develop a virulent type of the disease.

As stated above, a great many calves received from Hongkong for vaccine work have shown some of the first symptoms of the disease either upon the day of admission or within twenty-four hours thereafter. For this reason we have been giving all animals which have shown a temperature above normal, 50 c. c. of serum upon the day of admission, the remainder receiving the "simultaneous method" described below.

In these cases where serum alone is given, and where it is desired to confer permanent immunity, the calf is reinoculated with virulent blood alone after ten days. To obtain a reation in these cases we have found it necessary to give a dose of 15 to 25 c. c. of virulent blood when it is given within ten to thirty days after the primary inoculation, and even under these circumstances some calves will show no reaction.

SERUM SIMULTANEOUS METHOD.

This method, with the modification noted on page 20, is the one in use at this Laboratory, as well as at the principal points throughout the world where rinderpest is prevalent. It was first used by Kolle and Turner in their work in South Africa. It requires more skill than the bile method, as it is necessary to first prepare serum and then to obtain virulent blood from another animal sick with the disease.

When we first began inoculating in this Laboratory we used fresh virulent blood, but soon found that Edington's method of preserving it, in a solution of potassium citrate to prevent coagulation, was preferable. If the blood is kept in a cool place it can, according to our experience, be used for at least seven days with good results. Some authors maintain that it can be preserved for a longer period. The blood is drawn into a 500 c. c. sterile flask, which contains 25 c. c. of a 5 per cent solution of potassium citrate, so as to give 1.25 grams of potassium citrate to each flask.

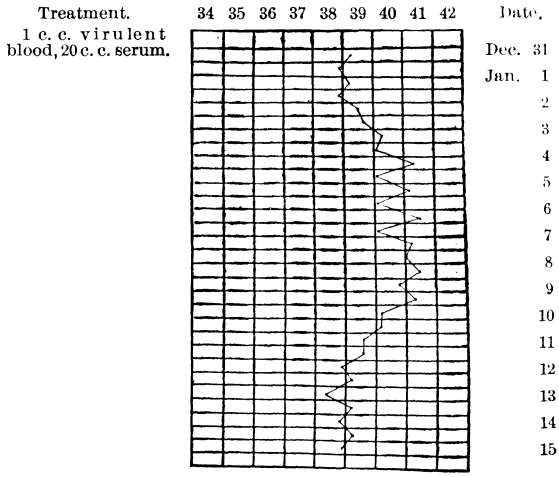
In using this method, the amount of serum necessary (which varies from 15 to 50 c. c., according to the susceptibility of the animal, as determined by experiment with others in the herd) is injected under the skin on one side of the animal, and 1 c. c. of the virulent blood on the opposite side and at the same time. If this amount of virulent blood were given without simultaneous inoculation of serum, it would invariably produce the disease in susceptible animals, but as the latter is given at the same time, it not only produces immediate partial immunity, but also aids the system in overcoming the toxic effects of the virulent blood; as a consequence a rise of temperature only is noted.

A temperature curve showing a good reaction after inoculation by the "simultaneous method" is shown in Chart No. 2.

CHART NO. 2.

Steer No. 72, December 31, 1902.

[Weight, 900 pounds; age, 4 years; sex, male; color, red; inoculation, rinderpest; history, inoculated December 31, 1902, with 1 c. c. virulent blood from cow No. 67, and serum 20 c. c.]



The advantages of this method are: First, the serum can be prepared and kept on hand in large quantities; second, it confers immediate partial immunity, which becomes much greater after the resulting reaction, and if the animal is in the incubation period at the time of inoculation the subsequent disease may be modified; third, the reactions are more even, under better control, and the immunity lasts longer than by any bile method; fourth, only one inoculation is required; fifth, in animals showing a reaction the immunity conferred is very effective and lasts for years, while a temporary immunity probably lasting for several months is conferred upon the ones having no reaction.

The disadvantages are: First, the inability to perfectly control the reactions by the regulation of the relation between the dose of virulent

blood and of serum; second, in order to obtain reactions in all animals, some cases require a second inoculation with virulent blood; third, to do the work properly it is necessary to take temperatures from the fourth day; fourth, the mortality, which is from 2 to 10 per cent, is higher than by any of the other methods described.

At this Laboratory we use the simultaneous method as modified by Rogers. The modification consists in taking the temperatures on and after the fourth day of all the animals inoculated, and those showing no reaction from the first inoculation are reinoculated after ten days with 10 c. c. of virulent blood.

The advantages of this method are: First, a reaction is obtained more often than by any other method; second, it is shown in a much larger percentage of cases; third, those animals having no reaction after the second inoculation will have a longer immunity conferred upon them than by the serum or any of the bile methods, although it is probably not of long duration.

The disadvantages are: First, that second inoculations are required in some cases; second, beginning on the fourth day, it is necessary to keep temperature records of the animals, thus necessitating a larger force of inoculators; third, the difficulties encountered in the provinces where the natives are in such marked opposition to the inoculations as to render it almost impossible in the outlying districts.

This method is to be preferred when practicable, as immunity extending over a long period is conferred upon the majority of the animals, while a temporary one is given to all. Rogers states that after a good reaction the immunity continues for years.

The work done at this Laboratory has been of too recent a date to determine the duration of the immunity in this country, but it will undoubtedly accord with Roger's experience.

DEFIBRINATED BLOOD METHOD.

This method originally recommended by Rogers may be used by cattle owners themselves.

It is first necessary to find an animal which has just recovered from the rinderpest; it is then bled, with all the precautions given on page 17, the blood being allowed to flow into a wide-mouthed vessel which has previously been sterilized. Then with an ordinary egg-beater or wire brush which has been boiled for at least fifteen minutes, the blood should be whipped for fifteen or twenty minutes, or until there is complete separation of the fibrin, which forms a stringy mass clinging to the egg-beater. The blood can then be used, as it will not coagulate; it is to be injected under the skin in doses of from 50 to 250 c. c. It must be used fresh, as it will soon spoil. It confers an immunity lasting from one to four months.

I believe that where the blood from a recently recovered animal is to be used for treatment or immunization, it would be better to draw the blood into a sterile flask or vessel containing the potassium-citrate solution. This would do away with the danger of contamination, which is often very difficult to prevent in the process of defibrination.

The advantages of this method are: First, it produces rapid immunity; second, the defibrinated blood is easily prepared on the field when animals which have recovered from the disease are present; third, there is no reactionary fever.

The disadvantages are: First, only a temporary immunity is obtained; second, the blood can not be kept; it must be fresh when used.

This method is one which should be of great benefit in distant provinces where it is impossible to obtain help or means for inoculation by the "simultaneous method." As immediate immunity is produced, it will be seen that with the exception of animals which already have the disease in its incubation period, no more will contract rinderpest during one to four months, the epidemic thus dying in its infancy.

TREATMENT.

Most of the writers whom we have been able to review and who have had experience with rinderpest, join in saying that no treatment is of any benefit when once an animal has contracted the disease, although some state that large doses of serum given subcutaneously exert a favorable action upon the course of the disease.

Serum has been used in very large doses with infected animals in this Laboratory, but, with the exception of two or three calves, we have been unable to detect any difference in the course of the disease, although a number of cases showed a transient fall in temperature. From the foregoing it is evident that prevention is the best treatment for rinderpest.

In case an epidemic breaks out in a locality the local health authorities should see that the infected animals are isolated, with all the precautions described on pages 14, etc.

The source of the primary infection should be traced if possible, and when found, suitable precautions should be taken to prevent reinfection after the disease is under control.

Where possible all the animals in the infected district should be immunized by the "simultaneous method." When expert help can not be obtained for this purpose the "defibrinated-blood method" or "Edington's glycerin and bile" method may be used by the cattle owners themselves.

Of these two latter methods I believe the "defibrinated-blood method" to be the best, as immediate immunity is produced, whereas with the "bile method" it is first necessary to allow the mixture to stand eight days before inoculating animals, and full immunity is not conferred until ten days after inoculation, so that after the first case appears it is eighteen days before the animals become immune.

As no treatment has any effect upon the course of rinderpest, and as it has been proven that an animal which has been inoculated and has shown a good reaction seldom contracts the disease, it is evident that it is not only necessary to inoculate all the animals now in the Philippine Islands but also those to be imported. By this means it will be possible to completely remove rinderpest from the Islands, but if such precautions are not taken, it will continue indefinitely, spreading from one point to another, killing off a large percentage of the young animals, and so working a continual hardship on the people.

O